The northernmost known observation of *Myrmecophilus acervorum* and the first records of Myrmecophilidae (Orthoptera, Ensifera) from Latvia

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Abstract

The first observations of myrmecophilous ant cricket *Myrmecophilus acervorum* (Panzer, 1799) and the family Myrmecophilidae from Latvia are presented. The observations were made in two locations subject to flooding in springtime. Adult and juvenile female individuals were observed. The discussed records appear to be the northernmost known distribution limit of this species.

Keywords

ant cricket, Baltic region, distribution, faunistic

Introduction

The ant cricket *Myrmecophilus acervorum* (Panzer, 1799) is among the smallest species of the entire order of orthopterans well-adapted to life in association with ants of the family Formicidae Latreille, 1802. The genus *Myrmecophilus* Berthold, 1827 is divided into three subgenera and holds 64 species, but *M. acervorum* is the only species known from Northern Europe (Cigliano et al. 2024).

Myrmecophilus acervorum is obligate ant kleptoparasite, meaning the crickets feed on ant eggs, cuticle wax, and ants-collected prey and receive nutrients through ant trophallaxis (Hölldobler and Kwapich 2022). Approximately 20 ant species are recorded to host *M. acervorum*, but there is a reported preference for the genus *Lasius* (Franc et al. 2015). Ant crickets disperse by crawling, usually following ant trails marked by pheromones (Kwapich et al. in prep., cited from Hölldobler and Kwapich 2022), and their dispersal ability is rather high (Franc et al. 2015). Relying on hosts like ants demands specific defense adaptations that in *M. acervorum* include chemotactile and body size mimicry and rapid zig zag-like escape movements (Akino 2008, Hölldobler and Kwapich 2022). When colonizing a new ant nest, the crickets accumulate ant cuticular hydrocarbons on their bodies that, in turn, reduces ant aggression, as ants use these substances as a nest-mate recognition cue (Akino 2008). Ant crickets lay up to four eggs per clutch under the ant brood pile, where they benefit from the controlled microclimatic conditions (Hölldobler and Kwapich 2022).

It was long considered that *M. acervorum* reproduces only parthenogenetically, yet recent studies have demonstrated that some populations consist of both males and females (Iorgu et al. 2021, Zafeiriou and Stalling 2023). *Myrmecophilus acervorum* is subject to geographic parthenogenesis, meaning that the choice of sexual or asexual reproduction depends on the geographic position of their locality; hence, the species is only facultative parthenogenetic (Iorgu et al. 2021). The sex ratio in the species is female-biased. While it has been hypothesized that this might be induced by bacterial endosymbiont *Wolbachia* infections promoting parthenogenesis (Werren et al. 2008, Tseng et al. 2020), the existence of *Wolbachia*-infected reproducing populations of *M. acervorum* with males contradicts this hypothesis (Iorgu et al. 2021), as does the lack of parthenogenetic populations with *Wolbachia* infections.

The Myrmecophilidae family lost wings and the ability to produce or hear sound (Song et al. 2020) most likely as a result of heavy reliance on its host species. There is no sexual dimorphism regarding body size observed in Myrmecophilidae crickets (Hochkirch and Gröning 2008); however, the body size is variable and adapts to host species, and the same specimen can change host species multiple times during the course of its life (Stalling et al. 2020, Hölldobler and Kwapich 2022). The best morphological features for species identification are the pale border at the base of the pronotum and distal part of tergite I and the emarginate subgenital plate (Stalling and Birrer 2013). Other characteristic traits

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include uniform body setation and metatarsal spines (Stalling and Birrer 2013). The first male individuals of the species were morphologically described very recently (Iorgu et al. 2021).

During the last decade, several new records and observations have been published for *M. acervorum* from Europe (Stalling et al. 2017, Tamutis et al. 2017, Kleukers et al. 2020, Hochkirch et al. 2021, Stalling and Seropian 2022, Iorgu et al. 2021, Gierlasinski 2022, Zafeiriou and Stalling 2023, Żurawlew et al. 2024). The species has been assessed as of Least Concern by the International Union for Conservation of Nature (IUCN) with an increase in population trending for the European region (Hochkirch et al. 2016a, b). In Central Europe, the species can be observed from early spring to late September (Franc et al. 2015). Individuals are usually found in ant nests in ruderal, urban, and other disturbed habitats (Franc et al. 2015, Stalling et al. 2017, Hörren et al. 2019). Notably, the association with ants is not compulsory, as individuals are often reported as occurring under rocks and wood pieces (Bönsel and Möller 2008, Franc et al. 2015), sometimes without traces of ants (Stalling and Seropian 2022).

The most recent catalogue of the Latvian orthopterans includes 43 species of six families (Starka et al. 2022). Here, we present the first records of *M. acervorum* in Latvia and briefly discuss its general distribution and ecology.

Material and methods

The present study is the result of non-systematic entomological investigations in central Latvia carried out by the first author in 2022–2024. The field studies were performed manually, searching for specimens in suitable habitats around and in nests of various ground- and wood-nesting ants.

The images of the specimens were taken *ex situ* using a Sony A7MIII camera and a Canon MP E 65 mm lens with a Metabones adapter and a Kuangren Twin Lite K–909 flash.

The biogeographical regions of Europe, provided by the European Environment Agency (version 1, 2016), were applied as a base map for regional distribution. Previous observations were extracted from the Global Biodiversity Information Facility (GBIF 2024). All layers were displayed in the ETRS89 LAEA Europe coordinate system. The regional extent of occurrence (EOO) and area of occupancy (AOO) were calculated using the online tool GeoCAT (Bachman et al. 2011).

One of the specimens discussed herein was preserved and is deposited in the collection of the Latvian National Museum of Natural History (LNDM) in Rīga. Another studied specimen was released after imaging.

Results

Family Myrmecophilidae Saussure, 1874
Genus *Myrmecophilus* Berthold, 1827

Myrmecophilus acervorum (Panzer, 1799)

Specimens examined.—LATVIA • 1 ♀ (Fig. 1A, B); Rīga, Bolderāja; 57°01'20"N, 24°01'06"E, altitude ~3 m a.s.l.; 19 May 2022; Aleksandrs Balodis leg.; xerothermic riverside, between River Buļļupe and Lielā Street north of Jaunie Bolderājas kapi cemetery; individual released after observation • 1 ♀, juv. (total body length: 1.47 mm, Fig. 1C, D); Rīga, Jugla, Strazdumuižas Street; 56°59'00"N, 24°15'32"E, ~4 m a.s.l.; 13 June 2024; Aleksandrs Balodis leg.; Lake Juglas sloping, semi-open shore (Fig. 1E, F); LNDM.

For localities in the WGS84 coordinate system, please refer to Suppl. material 1.

The observation near River Buļļupe comes from a mixed forest stand on sandy soil, in xerothermic conditions, with low grassy vegetation. The discussed specimen was observed on a fallen trunk of a birch tree, *Betula pendula*, cut about one year before (in 2021) and, along with other birch trunks, deposited (piled) about six months prior to the observation ~50 m from the riverside. The specimen was observed on the upper side of a trunk within a group of black *Lasius* sp. ants.

The observation at Juglas lakeside is from a partially open and moderately wet sloping edge of a lake with deciduous trees and bushes, at an east-exposed bank of the lake. The specimen was observed on black soil in a small group of black garden ants *Lasius niger* (Linnaeus, 1758).

Both localities are subjects of seasonal floods and water level fluctuation in the River Buļļupe and Lake Juglas, respectively. The straight-line distance between the localities is about 15.2 km.

Biogeographically, the Latvian records belong to the Boreal Region. The highest proportion of available records of *M. acervorum* come from the Continental Region followed by the Atlantic Region (Fig. 2). When compared to the previously known distribution (GBIF 2024), the Latvian contribution to the European regional EOO is 129 743 km^2 and to the AOO is 8 km^2.

Discussion

The species distribution range stretches over the southern and eastern parts of Western Europe, most of Central and Eastern Europe, the southern part of Northern Europe, western Caucasus, Central Asia (Kazakhstan, Uzbekistan), and southern West Siberia (Hochkirch et al. 2016b, SLU Artdatabanken 2024, GBIF 2024).

The previous northernmost localities of *M. acervorum* were multiple closely situated sites registered in GBIF (2021–2024), followed by Blomstermåla (56°58'51.6"N, 16°19'22.1"E) in Småland, south-eastern Sweden (Stalling et al. 2017), all in the same geographical cluster. In Asia, the northern- (and eastern-) most record comes from Barnaul (53°15'07"N, 83°44'22.5"E), Altai Krai, SW Siberia, Russia (Zalutsky et al. 2023). Both Latvian observation sites lie slightly north of the Swedish location and considerably north of the Siberian locality and can therefore be considered the northernmost known distribution limit of *M. acervorum*.

The discovery of *M. acervorum* in Latvia was expected considering the Lithuanian records (Tamutis et al. 2017), the Swedish distribution pattern of this species (SLU Artdatabanken 2024), and other recent records of the species range expansion in Europe (Stalling et al. 2017, Hörren et al. 2019, Kleukers et al. 2020, Hochkirch et al. 2021, Żurawlew et al. 2024) and Asia (Childebaev et al. 2014, Zalutsky et al. 2023). The species expansion to the north might be driven by climate change, as a similar pattern has been observed in other Orthoptera species (Starka et al. 2022). However, as discussed in previous research (Stalling et al. 2017, Zafeiriou and Stalling 2023), it is also possible that the species has long been overlooked due to its small body size and cryptic lifestyle.

It has been suggested that the species may spread anthropochorically via the transportation of soil, stone, and wood (Stalling et al. 2017, Hochkirch et al. 2021). It is also thought that it may have been unintentionally introduced to some parts of its Asian range where it is considered invasive (e.g., Zalutsky et al. 2023). The two Latvian localities reported here are from the two sides of River Daugava, the major Latvian river known both as a significant

geographic barrier and as an ecological migration corridor for entomofauna (e.g., Spuris 1971, Barševskis 1991, 1994). The possible role of River Daugava in the dispersal of *M. acervorum* in Latvia remains to be clarified.

Myrmecophilus acervorum is known to occur in the nests of many ant species (*Formica* spp., *Lasius* spp., *Myrmica* spp. and others), but it seems to prefer *Lasius*, most commonly *L. niger* (Franc et al. 2015, Stalling et al. 2017). Our observation from Jugla (13.

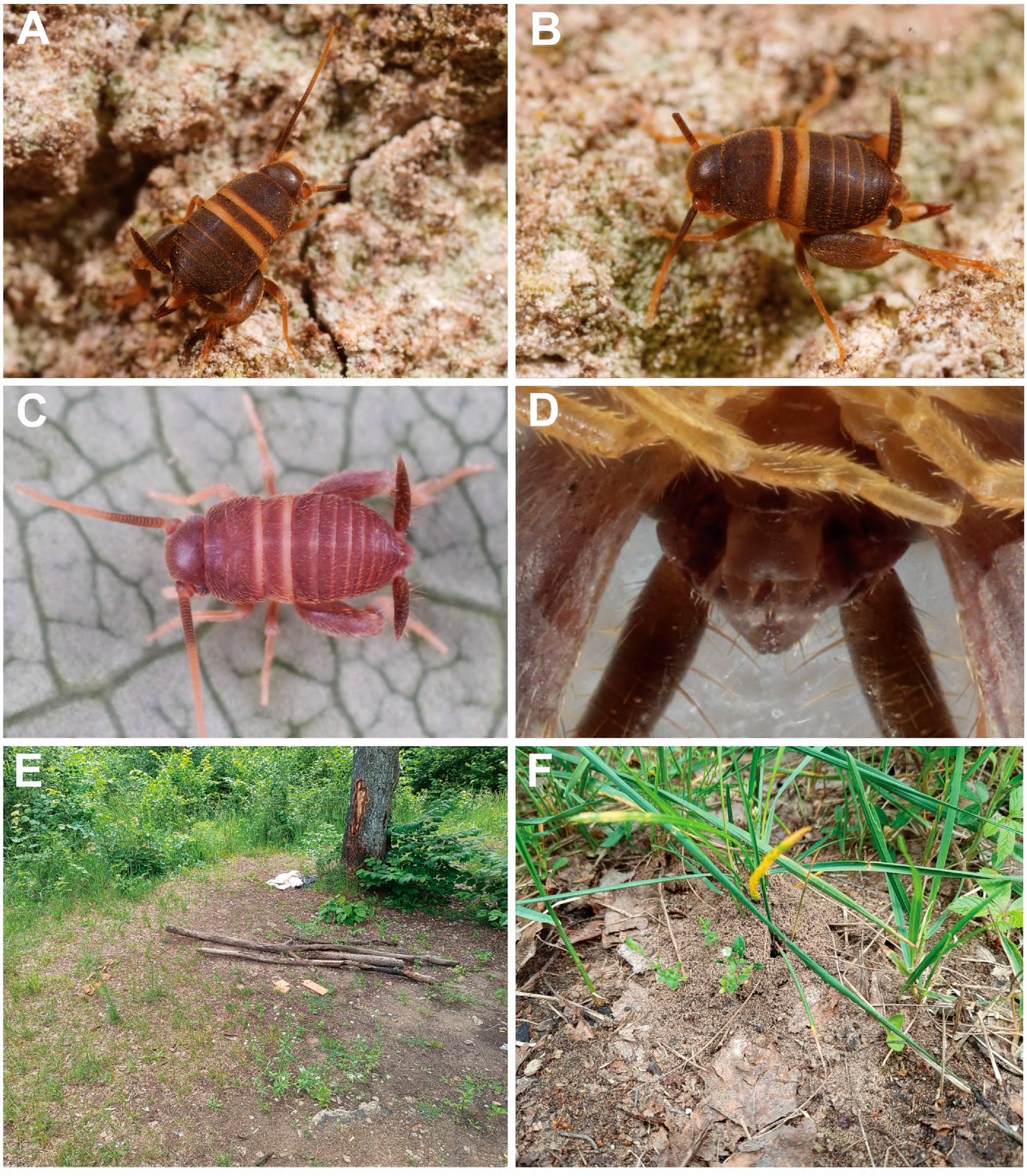

Fig. 1. Latvian specimens of *Myrmecophilus* (s. str.) *acervorum* (Panzer, 1799) and their habitat. **A, B.** Female from Buļļupe riverside, Rīga; **C, D.** Female nymph from Juglas lakeside, Rīga; **E, F.** Location of a *Lasius niger* nest at Lake Juglas in Rīga, where the nymph (Fig. 1C, D) was found. Images credits **A–C** and **E, F**: Aleksandrs Balodis; **D**: Uģis Piterāns.

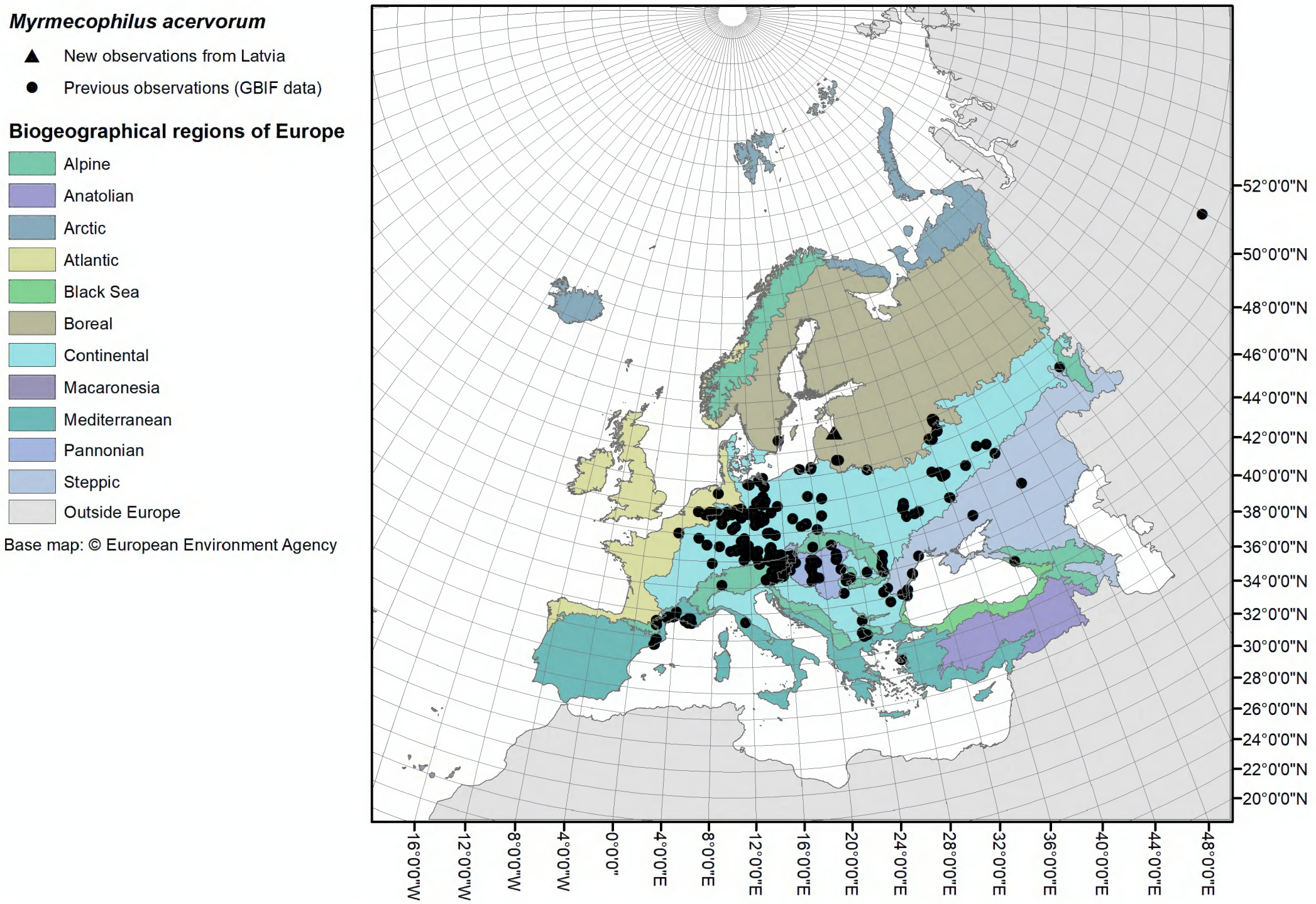

Fig. 2. Available (GBIF 2024) and new records of *Myrmecophilus acervorum* (Panzer, 1799) in various European biogeographical regions.

vi.2024) endorses the claim of preference for *L. niger* also at the very northern extent of the species' range.

According to the body size and development stage of the ovipositor (Junker 1997), our sampled juvenile individual is a second instar nymph. Nymph identification is problematic due to the lack of characteristic morphological features (Iorgu et al. 2021). However, *M. acervorum* is the only species occurring at this latitude (Cigliano et al. 2024), and the double pale margin on the basal part of the pronotum and tergite I (Fig. 1C, D) agrees with the features of *M. acervorum* (Stalling and Birrer 2013). Because the parthenogenesis of this species is known to be thelytoky, where females asexually produce only female offspring (Iorgu et al. 2021), we assume the Latvian subpopulation to be reproducing this way, since we observed both adult and juvenile female specimens. The presence or absence of *Wolbachia* and other endosymbionts in the Latvian population requires further study, and the presence of male individuals needs further confirmation. We conclude that *M. acervorum* is autochthonous in Latvian fauna.

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Supplementary material 1

Author: Aleksandrs Balodis, Rūta Starka, Dmitry Telnov
Data type: csv
Explanation note: Table of localities.
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Link: https://doi.org/10.3897/jor.34.138202.suppl1